National Training Aircraft Symposium (NTAS) 2022 - Bridging the Gap

Analysis of the Emerging Pilot Workforce

James Birdsong
Auburn University, james.birdsong@auburn.edu

Kurt Reesman
Auburn University, klr0051@auburn.edu

Analysis of the Emerging Pilot Workforce

National Training Aircraft Symposium (NTAS)

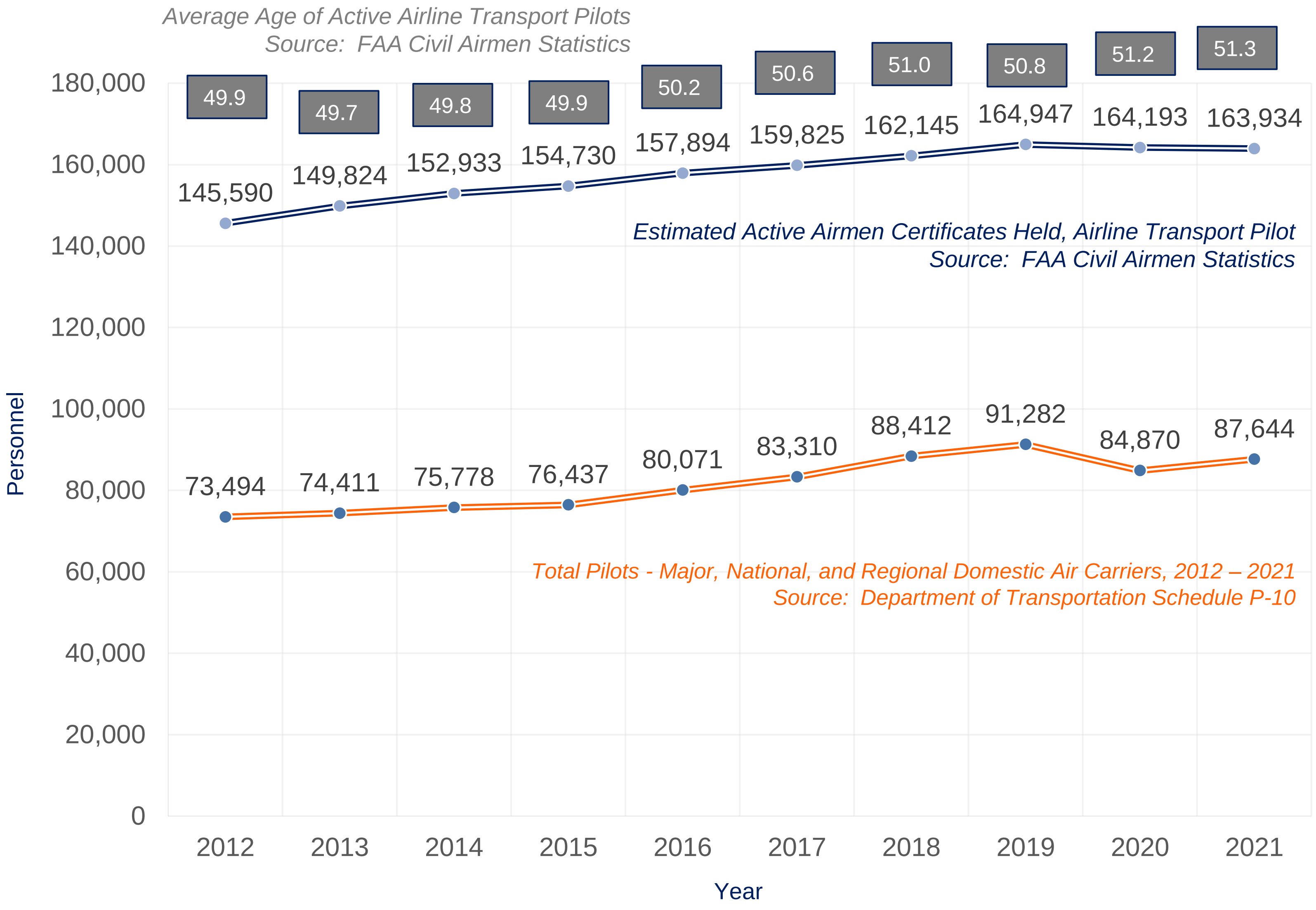
October 24, 2022

James Birdsong, PhD
Kurt Reesman, PhD

Overview

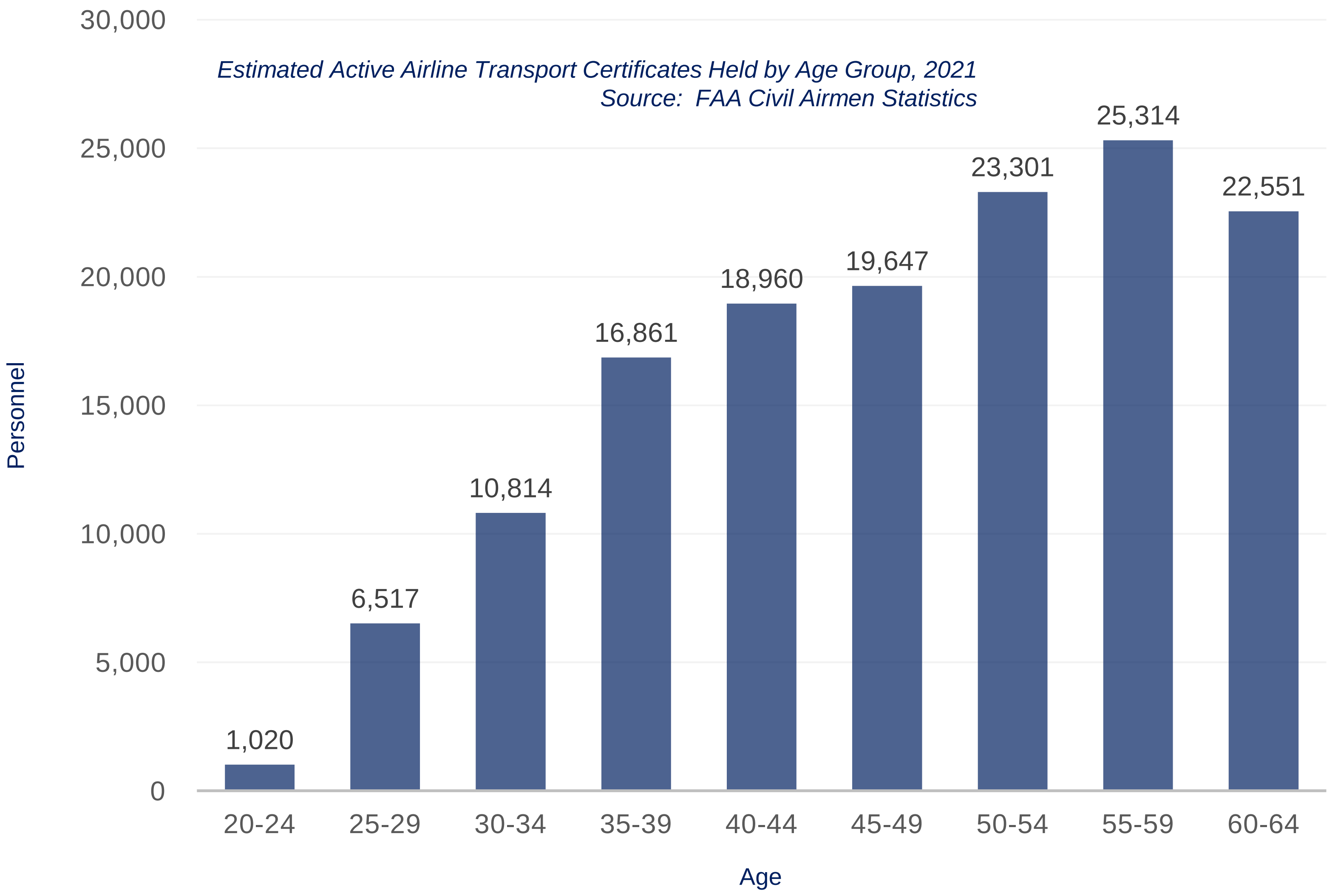
- Pilot workforce
- Generational considerations
- Training and technology
- Opportunities

Pilot workforce, 10-year snapshot



- The post-9/11, Great Recession lost decade
  - Bankruptcies
  - Mergers
  - Global recession
  - Stagnant careers
- Travel demand rebounded following the recession
  - Growth after 2012
- Increasingly (70%) civilian-trained
  - PL 111-216
  - Pathway programs
  - Airline academies
- COVID-19 impact
  - Retirements
  - Uneven global recovery
- Future industry growth

Pilot workforce, 2021



Per U.S. Bureau of Labor Statistics (BLS):

- 5.3% women
- 93.0% White
- 3.9% Black or African American
- 1.5% Asian
- 6.1% Hispanic or Latino

Due to the mandatory retirement age, the current Part 121 pilot workforce will lose almost 50% of its eligible pilot population within the next 15 years.

Generational composition

Generational Stratification

- Baby Boomers
  - Born 1946-1964
- Generation X
  - Born 1965-1980
- Generation Y (Millennials)
  - Born 1981-1996
- Generation Z
  - Born 1997-2012

Estimated Active Airmen Commercial and ATP Certificates Held by Generation, 2021

Age Group	Generation	Commercial	ATP	Total
20-24	Gen Z	14,481	1,020	15,501
25-29	Gen Y	19,366	6,517	25,883
30-34		12,923	10,814	23,737
35-39		10,667	16,861	27,528
40-44	Gen Y & X	8,262	18,960	27,222
45-49	Gen X	6,493	19,647	26,140
50-54		7,357	23,301	30,658
55-59	Gen X & Baby Boomer	7,829	25,314	33,143
60-64	Baby Boomer	8,096	22,551	30,647
Total		**95,474**	**144,985**	**240,459**

Baby Boomers will be gone in the next 10 years, leaving Gen X, Y, and Z at the helm – a workforce that will consist primarily of civilian-trained pilots who are digital natives and digital immigrants.

Sources: Pew Research Center and Population Reference Bureau
FAA Civil Airmen Statistics

Generational considerations (general population)

Generation X	Generation Y	Generation Z
Generations*	VR motivates and engages (Reilly, 2012)	Brains wired to sophisticated, complex visual imagery (Hallowell & Ratey, 2011; Rothman, 2016)
	Attention span 12 seconds (Shatto & Erwin, 2016)	Attention span 8 seconds (Shatto & Erwin, 2016)
Hardworking, independent, skeptical (Lancaster & Stillman, 2002)	Prefers groupwork with hands-on experiences (Eckleberry-Hunt & Tucciarone, 2011); Team-oriented (Howe & Strauss, 1993)	Self-directed; thrive on technology* (Shatto & Erwin, 2016); Prefers interactive games, collaborative projects, and challenges (Rothman, 2016)
	“How-to” guide for success (Monaco & Martin, 2007; Reilly, 2012); Wants immediate feedback and lacks critical thinking skills (Monaco & Martin, 2007);	Likes Google, lacks ability to vet information (Shatto & Erwin, 2016; Pew Research Center, 2014)
	Less lecture with creative, interactive, fun learning (Eckleberry-Hunt & Tucciarone, 2011) *Edutainment*	Prefers less lecture and more interaction (Shatto & Erwin, 2016)
Digital immigrants (Prensky, 2001)	Digital natives (Prensky, 2001)	Digital natives (Prensky, 2001)
Good at multi-tasking (Williams, 2014)	Prefer to multi-task rather than focus on one thing (McCrindle Research, 2016; Worley, 2011)	

Generational considerations (aviation)

- Despite generational shifts, the characterizations of flight students and how they learn have remained stable.
- Decades of research has characterized pilots and flight students as emotionally stable, highly assertive and conscientious, competitive and striving for high achievement, and tending toward higher levels of extraversion (Campbell et al., 2009; Fitzgibbons et al., 2004; Gao & Kong, 2016).
- Flight students use reasoning, theoretical models, and observations to form explanations and may prefer abstract conceptualization, in which learning occurs through logical thinking and planning (Harriman, 2011; Kanske & Brewster, 2001). (Fussell & Thomas, 2021, p. 5).

Training methods

- Adult learners (Pedagogy vs. Andragogy)
- Systematic approach
  - Instructional System Design (ISD)
    - ADDIE (Analyze, Design, Develop, Implement, & Evaluate)
  - Over 90% of all airline pilots in the U.S. are training under the systematic Advanced Qualification Program (AQP) (Farrow, 2019 & FAA, n.d.),
    - AQP uses a data-driven systematic approach to training that allows regulatory flexibility, incentivizes air carrier participation, and integrates scenario-based individual and crew training and evaluation
- Distant learning before coming to training (or recurrency)
- Research identifies characteristics unique to each generation; however, some argue that claims about the differences between digital native and digital immigrant generations and the use of technology in learning do not exist.
  - They admit that while change is necessary for the classroom, focusing on generational characteristics to build a curriculum should not be a factor (Bullen et al., 2011; Kennedy et al., 2007).

Technology (simulators)

- Flight simulators and training devices have been widely used since the 1960s (Schaffernak et al., 2020)
  - Increased efficiency, safety, and lower training costs (Harris, 2011)
- Simulators vary according to fidelity, the degree to which it mimics real-world tasks (Myers et al., 2018)
  - Divided into physical (e.g., sound, visual input, sensation) and psychological-cognitive (e.g., mental workload, psychological pressure, attentional demand, etc.) fidelity fields (Macchiarella & Mirot, 2018)
  - Studies have shown that lower-level simulation devices are effective pilot training devices (Stewart et al., 2008; Risukhin et al., 2016; Reweti et al., 2017; Taylor et al., 1999; Taylor et al., 2005; Baker et al., 1993; Johnson et al., 1997; Brannick et al., 2005; Rosa et al., 2021)
- Simulation and technology alone do not provide training nor guarantee that learning occurs (Salas et al., 1998)
  - Learning occurs through a systematic approach to designing, developing, and evaluating curricula

Technology (eLearning)

- Computer-based training (CBT) evolved, now commonly known as eLearning
  - Ability to deliver training to many users through multiple channels and formats
- Synchronous and asynchronous (self-pacing) delivery
  - Self-pacing may lead to a higher level of motivation (Clark and Mayer, 2008 in Kearns, 2010) and is a good strategy for novice skill-based learning (Kraiger & Jerden, 2007)
- Kearns (2010)
  - Asynchronous eLearning results in better learning than synchronous eLearning
  - Blended learning results in better education than either synchronous or asynchronous delivery alone
  - Generally, one could expect no significant differences in learning outcomes between eLearning and classroom-based courses developed with the same instructional content
- New technology allowing eLearning to be delivered in 3D (vs. 2D)
  - Ability to integrate with other technologies (e.g., eye tracking, intelligent tutor), elements of gamification (e.g., motivation, scoring, immediate feedback)

USAFA VR labs

UNITED STATES
AIR FORCE
ACADEMY

Benefits, limitations of VR compared to traditional sims

Benefits

- Reduced costs
- Flexible, rapid HMI component integration
- More realistic feel than the classroom
- Ability to network systems
- Augment/replace CBT, classroom; improved performance before sim
- Strengthen cognitive ability, improve attention, promote neuroplasticity
- Group training, copilot avatar
- Encourages creativity during learning through exploration
- On-demand, site independent

Performance limitations

- Limited FoV, FoR, DoF, resolution
- Limited usability of virtual controls
- Increased physical workload, restricted movement
- Simulator sickness
- Slow refresh and frame rate, high latency
- Ill-fitting equipment
- Participant comfort level
- Lack of immersion
- Expense
- Window management, confusion

Note: XR/ITDs are not one-size fits all ($-$$$)

Cross, J. I., Boag-Hodgson, C., Ryley, T., Mavin, T., & Potter, L. E. (2022). Using Extended Reality in Flight Simulators: A Literature Review. *IEEE Transactions on Visualization and Computer Graphics*, 1–1. https://doi.org/10.1109/TVCG.2022.3173921

Call to action

- The FAA categorized level, type, and frequency of use for all FSTD devices.
- Because current XR technology is so new and is developing rapidly, the FAA hasn't had the opportunity to provide the same type of guidance.
- The FAA needs empirical data to develop guidance for using XR in training
  - Data needs to represent the broad capabilities of the technology available, what type of training it is being used for, and how much of it is needed to work
  - Data needs to represent the changing diversity in the workforce
- We need more research data to inform the FAA!

THANK YOU

QUESTIONS | DISCUSSION

References

- Airline and Commercial Pilots: Occupational Outlook Handbook: U.S. Bureau of Labor Statistics. (n.d.). Retrieved December 8, 2021, from https://www.bls.gov/ooh/transportation-and-material-moving/mobile/airline-and-commercial-pilots.htm
- Baker, D., Prince, C., Shrestha, L., Oser, R. & Salas, E. (1993). Aviation computer games for crew resource management training. International Journal of Aviation Psychology, 3(2), 143-156. DOI: 10.1207/s15327108ijap0302_4
- Brannick, M. T., Prince, C., & Salas, E. (2005). Can pc-based systems enhance teamwork in the cockpit? The International Journal of Aviation Psychology,15(2), 173-187, DOI: 10.1207/s15327108ijap1502_4
- Bullen, M., Morgan, T., & Qayyum, A. (2011). Digital learners in higher education: Generation is not the issue. Canadian Journal of Learning and Technology, 37(1), 1-24.
- Campbell, J. S., Castaneda, M., & Pulos, S. (2009). Meta-analysis of personality assessments as predictors of military aviation training success. *The International Journal of Aviation Psychology, 20*(1), 92-109
- Clark, R. C., & Mayer, R. E. (2008). E-Learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning. Pfeiffer.
- Cross, J. I., Boag-Hodgson, C., Ryley, T., Mavin, T., & Potter, L. E. (2022). Using Extended Reality in Flight Simulators: A Literature Review. IEEE Transactions on Visualization and Computer Graphics, 1–1. https://doi.org/10.1109/TVCG.2022.3173921
- Dimock, M. (n.d.). Defining generations: Where Millennials end and Generation Z begins. Pew Research Center. Retrieved May 9, 2022, from https://www.pewresearch.org/fact-tank/2019/01/17/where-millennials-end-and-generation-z-begins/
- Eckleberry-Hunt, J., & Tucciarone, J. (2011). The challenges and opportunities of teaching “generation y.” Journal of Graduate Medical Education, 3(4), 458–461. https://doi-org.spot.lib.auburn.edu/10.4300/JGME-03-04-15
- Farrow, D. (2019). A regulatory perspective II. In B. G. Kanki, J. Anca, & T. R. Chidester (Eds.), Crew resource management (pp. 465–487). Elsevier Academic Press.
- Federal Aviation Administration (FAA). (n.d.). Advanced qualification program. https://www.faa.gov/training_testing/training/aqp/

References (2/4)

- Fitzgibbons, A., Schutte, P., & Davis, D. (2004). Pilot personality profile using NEO-PI-R. National Aeronautics and Space Administration.
- Fussell, S. G., & Thomas, R. (2021). Interactive Modules for Flight Training: A Review. Journal of Aviation/Aerospace Education & Research, 30(2). https://doi.org/10.15394/jaaer.2021.1901
- Gao, Y., & Kong, S. (2016). Personality types of pilot students: A study of an Australian collegiate aviation program. *International Journal of Aviation, Aeronautics, and Aerospace*, *3*(3), 1–16.
- Hallowell, E., & Ratey, J. (2011). Driven to distraction: Recognizing and coping with attention deficit disorder. Anchor Books.
- Harriman, S. L. (2011). *The impact of collegiate aviation student learning styles on flight performance: A scenario-based training approach* [Doctoral dissertation, Purdue University].
- Harris, D. (2011). Human performance on the flight deck. Ashgate.
- Howe, N., & Strauss, W. (1993). Millennials rising: The next greatest generation. Vintage Books.
- Johnson, N., McDonald, N. & Fuller, R. (1997). Aviation psychology in practice. Aldershot: Avebury Aviation.
- Kanske, C. A., & Brewster, L. (2001). The learning styles of college aviation students. *Collegiate Aviation Review International*, *19*(1), 62–70.
- Kearns, S. K. (2010). E-Learning in Aviation. Ashgate.
- Kearns, S. K., Mavin, T. J., & Hodge, S. (Eds). (2020). Engaging the next generation of aviation professionals. Routledge.
- Kennedy, G., Dalgarnot, B., Gray, K., Judd, T., Waycott, J., Bennett, S., Maton, K., Krause, K.,Bishop, A., Chang, R., & Churchward, R. (2007). The net generation are not big users of Web 2.0 technologies: Preliminary findings. In ICT: Providing choices for learners and learning. Proceedings ascilite Singapore 2007.
- Kraiger, K., & Jerden, E. (2007). A meta-analytic investigation of learner control: Old findings and new directions. In S. M. Fiore and E. Salas (Eds.), Toward a science of distributed learning (pp. 65-90). American Psychological Association.

References (3/4)

- Lancaster, L. C., & Stillman, D. (2002). When generations collide: Who they are, why they clash, how to solve the generational puzzle at work. Harper Collins.
- Macchiarella, N., & Mirot, A. (2018). Scenario Development for Unmanned Aircraft System Simulation-Based Immersive Experiential Learning. Journal of Aviation/Aerospace Education & Research. https://doi.org/10.15394/jaaer.2018.1773
- McCrindle Research. (2006). New generations at work: Attracting, recruiting, and training Generation Y. Downloaded from McCrindle Research at www.tanz.ac.nz/pdf/NewGenerationsAtWork.pdf.
- Monaco, M., & Martin, M. (2007). The Millennial Student: A New Generation of Learners. Athletic Training Education Journal, 2(2), 42–46.
- Myers, P., Starr, A., & Mullins, K. (2018). Flight Simulator Fidelity, Training Transfer, and the Role of Instructors in Optimizing Learning. International Journal of Aviation, Aeronautics, and Aerospace. https://doi.org/10.15394/ijaaa.2018.1203
- Pew Research Center. (2014). Millennials in adulthood: Detached from institutions, networked with friends. Retrieved from http://www.pewsocialtrends.org/2014/03/07/millennials-in-adulthood/
- Prensky, M. (2001). Digital Natives, Digital Immigrants Part 1. On the Horizon, 9(5), 1–6. https://doi.org/10.1108/10748120110424816
- Reilly, P. (2012). Understanding and Teaching Generation Y. English Teaching Forum, 50(1), 2–11.
- Reweti, S., Gilbey, A., & Jeffrey, L. (2017). Efficacy of low-cost pc-based aviation training devices. Journal of Information Technology Education: Research, 16, 127–142. Retrieved from http://www.informingscience.org/Publications/3682
- Risukhin, V., Thompson, R., Hasenick, S., Whitehurst, G., Rantz, W., Utkan, F., Caldwell, B., Johnson, M., Motevalli, P., & Udo-Imeh, N. (2016, June 13-17). Integration of affordable information technology products into general aviation training and research [Paper presentation]. 16th AIAA Aviation Technology, Integration, and Operations Conference, General Aviation Safety Session, Washington, DC, United States. https://doi.org/10.2514/6.2016-3917
- Rosa, E., Dahlstrom, N., Knez, I., Ljung, R., Cameron, M. & Willander, J. (2021). Dynamic decision-making of airline pilots in low-fidelity simulation, Theoretical Issues in Ergonomics Science, 22:1, 83–102, DOI: 10.1080/1463922X.2020.1758830

References (4/4)

- Rothman, D. (2016). A Tsunami of Learners called Generation Z. Retrieved from http://mdle.net/Journal/A_Tsunami_of_Learners_Called_Generation_Z.pdf
- Salas, E., Bowers, C. A., & Rhodenizer, L. (1998). It Is Not How Much You Have but How You Use It: Toward a Rational Use of Simulation to Support Aviation Training. The International Journal of Aviation Psychology, 8(3), 197–208. https://doi.org/10.1207/s15327108ijap0803_2
- Schaffernak, H., Moesl, B., Vorraber, W., & Koglbauer, I. V. (2020). Potential augmented reality application areas for pilot education: An exploratory study. Education Sciences, 10(4), 86. MDPI AG. Retrieved from http://dx.doi.org/10.3390/educsci10040086
- Shatto, B., & Erwin, K. (2016). Moving on From Millennials: Preparing for Generation Z. Journal of Continuing Education in Nursing, 47(6), 253–254. https://doi-org.spot.lib.auburn.edu/10.3928/00220124-20160518-05
- Stewart, J. E., Johnson, D. M. & Howse, W. R. (2008, April). Fidelity requirements for army aviation training devices: Issues and answers. U.S. Army Research Institute. https://apps.dtic.mil/sti/citations/ADA493584
- Taylor, H. L., Lintern, G. Hulin, C. L., Talleur, D. A., Emanuel, T. W., & Phillips, S. I. (1999). Transfer of training effectiveness of a personal computer aviation training device, The International Journal of Aviation Psychology, 9(4), 319–335, DOI: 10.1207/s15327108ijap0904_1
- U.S. Civil Airmen Statistics | Federal Aviation Administration. (n.d.). Retrieved September 11, 2022, from https://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics
- U.S. Government Accountability Office (GAO). (2014, February). Aviation workforce: Current and future availability of airline pilots. Retrieved from https://www.gao.gov/assets/gao-14-232.pdf
- Williams, C. J., Matt, J. J., & O’Reilly, F. L. (2014). Generational perspective of higher education online student learning styles. Journal of Education and Learning, 3(2), 33–51. https://doi.org/10.5539/jel.v3n2p33
- Worley, K. (2011). Educating College Students of the Net Generation. Adult Learning, 22(3), 31–39. https://doi-org.spot.lib.auburn.edu/10.1177/104515951102200305